MONDAY

Gonzalo J. Olmo
Depto. Física Teórica & IFIC, UV-CSIC

Cracking Ricci-based theories of gravity.

We show that the space of solutions of a wide family of Ricci-based metric-affine theories of gravity can be put into correspondence with the space of solutions of General Relativity (GR). This allows to use well established methods and results from GR to explore new gravitational physics beyond it.

Ruth Lazkoz
Dept. of Theoretical Physics and History of Science, UPV-EHU

Forecast and analysis of the cosmological redshift drift

The cosmological redshift drift could lead to the next step in high-precision cosmic geometric observations, becoming a direct and irrefutable test for cosmic acceleration. In order to test the viability and possible properties of this effect, also called Sandage-Loeb (SL) test, we generate a model independent mock data set so as to compare its constraining power with that of the future mock data sets of Type Ia Supernovae (SNe) and Baryon Acoustic Oscillations (BAO). The performance of those data sets is analyzed by testing several cosmological models with Markov chain Monte Carlo (MCMC), both independently and combining all data sets. Final results show that, in general, SL data sets present allow for remarkable constrains on the matter density parameter today on every tested model, showing also a great complementarity with SNe and BAO data regarding dark energy (DE) parameters.

Alejandro Jiménez Cano
Depto. de Física Teórica y del Cosmos, U. Granada

Palatini-Metric equivalence in EH gravity and beyond

It is often said that the unique solution of Einstein-Hilbert gravity in the Palatini formalism is the Levi-Civita connection. However, typically symmetric connection or metricity condition is assumed. If we vary in the general case (under some hypothesis on the matter lagrangian), we obtain a set of connections, a result that reflects the so-called projective symmetry of the theory. The general solution of the equations of motion extends the Levi-Civita description to a new family of connections with different geometrical properties (different curvature, for instance) and some interesting features such as the homothetic parallel transport. All of this conspires and the results from both formalisms turn out to be the same, as we showed in the recent publication [1].

With this work as a starting point, I have focused my PhD thesis on two main points. The first one is analysing the implications of a physical connection, remarking the crucial role of the irreducible components of the torsion and non-metricity. The other one is the study of those connections whose autoparallel trajectories coincide with the metric ones, treating this connection as the fundamental and physical one (physical curvature, torsion and non-metricity). Under these conditions we obtain a geometry different from others that have been studied in detail such as Riemann-Cartan, Weyl, and so on.

[1] A. N. Bernal, B. Janssen, A. Jiménez-Cano, J.A. Orejuela, M. Sánchez, P. Sánchez-Moreno.
On the (non-)uniqueness of the Levi-Civita solution in the Einstein-Hilbert-Palatini formalism.
Physics Letters B **768** (2017) 280-287

TUESDAY

Diego Rubiera-García
Instituto de Astrofísica e Ciências do Espaço, U. Lisboa

Metric-affine f(R,T) theories

I will talk about some preliminary elements of an ongoing work on f(R,T) theories of gravity in metric-affine spaces. I will show that these theories can be handled in a similar way as standard metric-affine f(R) theories and, with more generality, any Ricci-based theory of gravity. I will also discuss briefly the conservation equation, the Newtonian limit, and some potential applications of these theories.

Diego Sáez Gómez
Instituto de Ciencias del Espacio (ICE-CSIC/IEEC)

Dark energy and dark matter: a dark interaction?

As pointed by the observations, the Universe expansion is increasing its speed. Nevertheless, how this acceleration works is still a mystery that has been called dark energy. Over the recent years, some dark energy models that interact with dark matter have been proposed. The phenomenogical form of this interaction can be easily modelled through the continuity equations, circumventing the theoretical issue behind. Some of these models reveal the possibility of the occurrence of a future singularity, a framework widely studied in the literature and supported by the observations, as will be shown. In this talk, I will review some basic concepts on cosmology and general relativity, and show the physical features of an interaction among dark energy and dark matter, and the occurrence of a future singularity induced precisely by such interactions. Some open questions will be also raised.

Iker Leanizbarrutia
Dept. of Theoretical Physics and History of Science, UPV-EHU

Testing the Duality-Distance Relation with present and future data

In order to test deviations of the Distance Duality relation, we introduce and fit several functions that model different deviations using latest BOSS and WiggleZ data for angular diameter distance, and Union2.1 catalog alongside Gaussian Process to extract the luminosity distance at the proper redshifts. Used data shows no significant deviation from the distance-duality relation, but the resulting fits are now used as fiducial models to create different mock data sets based on specifications of various future surveys. This way, we constrain each model using mock datasets created by themselves and we compare to the real data result, showing that in every case the future survey mock data distinguish the fiducial model from the null case. Thus, the future surveys are very promising, having the possibility to confirm with high precision any feeble deviation from the Distance Duality relation done by current observations.

WEDNESDAY

Victor Ignacio Afonso
U. Acadêmica de Física, Universidade Federal de Campina Grande (Brasil)

Scalar geons in Born-Infeld gravity

The notion of **geon**, introduced by Wheeler to identify self-gravitating free electromagnetic fields, reappears in the metric-affine theories context in a natural way. In this talk I will discuss the results obtained in the case of Born-Infeld Gravity (BI) model coupled to scalar matter. We show that static, spherically symmetric, self-gravitating scalar field solutions indeed exist in the Palatini approach and, quite surprisingly, wormhole structures are spontaneously formed, even when there are no fluxes related to the real scalar field to support them.

Antonio Sánchez Puente
Depto. Física Teórica & IFIC, UV-CSIC

Life beyond a curvature divergence

In this talk I will present the fate of an observer that approaches a curvature divergence, modeled by a geodesic path or a congruence of geodesics. It will shown that not all curvature divergences are destructive singularities, in particular, for charged black holes in Metric-Affine extension of gravity, which have a wormhole structure instead of central singularty that contains curvature divergences at the throat.

Emanuele Orazi
Universidade Federal do Rio Grande do Norte (Natal, Brasil)

On the rôle of torsion in Ricci-based theories of gravity

We study a large family of metric-affine theories with a projective symmetry, including non-minimally coupled matter fields which respect this invariance. The symmetry is straightforwardly realised by imposing that the connection only enters through the symmetric part of the Ricci tensor, even in the matter sector. We leave the connection completely free (including torsion) and obtain its general solution as the Levi-Civita connection of an auxiliary metric, showing that the torsion only appears as a projective mode. This result justifies the widely used condition of setting vanishing torsion in these theories as a simple gauge choice. We apply our results to some particular cases considered in the literature like the so-called Eddington-inspired-Born-Infeld theories among others. We finally discuss the possibility of imposing a gauge fixing where the connection is metric compatible and comment on the genuine character of the non-metricity in theories where the two metrics are not conformally related.

THURSDAY

Michele Ronco
Università de La Sapienza (Roma)

Shaking general covariance

I will start discussing general covariance in the form of hypersurface deformations for smooth Riemannian manifolds. However, this perspective is expected to be particularly useful to explore the effects of non-classical spacetimes on symmetry structures in a general way, without resorting to any specific theory. In particular, in this talk I will discuss an ongoing work on the generalisation of the brackets of space and time deformations in presence of torsion and non-metricity, two key features of generalised geometric frameworks.

José Navarro-Salas
Depto. Física Teórica & IFIC, UV-CSIC

The many faces of gravitational particle creation

The gravitational particle creation phenomena has been acquired many different faces. After giving a historical and pedagogical overview, ranging from cosmology, black holes and strong QED, we focus on its connection to the quantum mechanical breaking of global symmetries.

Alessandro Fabbri
Depto. Física Teórica & IFIC, UV-CSIC

Quantum backreaction in rotating BTZ black holes

Exact analytical solution of the quantum backreaction equations for 2+1 rotating BTZ black holes and naked singularities is presented and the physical consequences are discussed.

FRIDAY

Today we will follow a discussion led by Gonzalo J. Olmo to design the group's research activity for 2018. An overview of recent developments of ongoing collaborations will be presented highlighting the most relevant achievements and open questions in the field.

The strategy for next year regarding dissemination, conferences, and other activities will be discussed by the group, including the current budget capabilities and prospects for hiring postdocs and new graduate students.